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Indian Standard

SPECIFICATION FOR FERROSILICON FOR EXPLOSIVE AND PYROTECHNIC INDUSTRY

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Indian Standard

SPECIFICATION FOR FERROSILICON FOR EXPLOSIVE AND PYROTECHNIC INDUSTRY

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Indian Standard

SPECIFICATION FOR FERROSILICON FOR EXPLOSIVE AND PYROTECHNIC INDUSTRY

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 15 September 1986, after the draft finalized by the Explosives and Pyrotechnics Sectional Committee had been approved by the Chemical Division Council.

0.2 There is already an Indian Standard available on ferrosilicon (IS: 1110-1981*) which covers the requirement of ferrosilicon for use in iron and steel industry. However, Ferro Alloys Sectional Committee, SMDC 8, while considering the suggestion of Explosive and Pyrotechnics Sectional Committee, CDC 51, and the Ministry of Defence to consider requirements of pyrotechnic industry felt that it would be desirable to formulate a separate standard for pyrotechnic use, as it would be outside the scope of that Committee to cover such requirements. Therefore, this Indian Standard has been formulated with a view to cover the requirements for ferrosilicon for explosive and pyrotechnic industry.

0.3 Ferrosilicon is generally used as a fuel in the pyrotechnic industry.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard prescribes the requirements and the methods of sampling and tests for ferrosilicon for use in explosive and pyrotechnic industry.

*Specification for ferrosilicon (*third revision*).

†Rules for rounding off numerical values (*revised*).

2. GRADES

2.1 The material shall be of following two grades based on the total silicon content:

Grade I — having total silicon content not less than 85 percent, and

Grade II — having total silicon content not less than 70 percent.

3. TYPES

3.1 The material shall be of types A, B and C based on its sieve size as specified in Table 1.

TABLE 1 REQUIREMENTS FOR FERROSILICON FOR USE IN EXPLOSIVE AND PYROTECHNIC INDUSTRY

(*Clauses* 3.1 *and* 4.2)

SL NO.	CHARACTERISTIC	REQUIREMENT	METHOD OF TEST (REF TO CL NO.)
(1)	(2)	(3)	(4)
i)	Moisture, percent by mass, *Max*	0·05	A-2
ii)	Matter soluble in water, percent by mass, *Max*	0·25	A-3
iii)	*p*H (of aqueous extract)	7·5-9·0	A-4
iv)	Total silicon, percent by mass, *Min*		A-5
	a) Grade I	85	
	b) Grade II	70	
v)	Fineness:		A-6
	a) For Type A (lumps)		
	— retained on 2 000 micron IS Sieve, percent by mass, *Min*	97	
	b) For Type B		
	— retained on 106 micron IS Sieve, percent by mass, *Max*	Nil	
	— retained on 63 micron IS Sieve, percent by mass, *Max*	20	
	c) For Type C		
	— retained on 90 micron IS sieve, percent by mass, *Max*	Nil	
	— retained on 63 micron IS sieve, percent by mass, *Max*	10	

4. REQUIREMENTS

4.1 The material shall be of good quality, in the form of powder or lumps and shall be free from visible impurities or foreign matter.

4.2 The material shall comply with the requirements laid down in Table 1 when tested according to the methods prescribed in Appendix A. Reference to the relevant clauses of Appendix A is given in col 4 of Table 1.

5. PACKING

5.1 The material shall be supplied in securely closed, clean and dry galvanized mild steel drums (*see* IS : 2552-1979*) or in such containers as agreed to between the purchaser and the supplier.

6. MARKING

6.1 Each container shall be legibly and indelibly marked with the following information:

a) Name of material, and its grade and type;

b) Gross and net mass of material;

c) Name of the manufacturer and/or his trade-mark, if any; and

d) Batch No., in code or otherwise, to enable the batch to be traced from records.

6.2 The container may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7. SAMPLING

7.1 The method of sampling and the criteria for conformity of the material to the requirements of this standard shall be as prescribed in Appendix B.

*Specification for steel drums (galvanized and ungalvanized) (*second revision*).

APPENDIX A

(*Clause* 4.2)

A-1. QUALITY OF REAGENTS

A-1.1 Unless specified otherwise, pure chemicals and distilled water (*see* IS:1070-1977*) shall be employed in the test.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

A-2. DETERMINATION OF MOISTURE

A-2.1 Procedure — Weigh about 10 g of the material in a weighed petri dish. Keep in an oven adjusted to a temperature of 105 ± 2°C for 2 hours. Remove the dish to a desiccator for about half an hour to cool, and reweigh it. Repeat the process till constant mass is obtained.

A-2.2 Calculation

$$\text{Moisture, percent by mass} = \frac{M_1 - M_2}{M_1 - M} \times 100$$

where

M = mass in g of the empty dish,

M_1 = mass in g of the material and the dish before heating, and

M_2 = mass in g of the material and the dish after heating.

A-3. DETERMINATION OF MATTER SOLUBLE IN WATER

A-3.1 Procedure — Treat 15 g of the material with 300 ml of freshly boiled water. Boil gently in a covered vessel for 15 minutes. Cool to room temperature and filter. Wash the filter paper twice with 15 ml of water. Make up the volume to 500 ml in a volumetric flask. Take 100 ml of the filterate and evaporate to dryness in a tared porcelain dish on a water bath. Dry for one hour at 103 to 105°C. Cool in a desiccator and weigh.

A-3.2 Calculation

$$\text{Water soluble matter, percent by mass} = (M_2 - M_1) \times \frac{100}{M}$$

where

M = mass in g of the material present in the aliquot (taken for test),

M_1 = mass in g of the empty dish, and

M_2 = mass in g of the dish and residue.

*Specification for water for general laboratory use (*second revision*).

A-4. DETERMINATION OF *p*H

A-4.1 Procedure — Weigh about 10 g of the material and transfer it to a 250-ml beaker. Add 100 ml of freshly boiled and cooled water. Allow to stand for 30 minutes with occasional stirring. Filter, reject the first 50 ml of the filtrate and collect the remaining filtrate in a beaker. Determine the *p*H of the solution by means of a suitable *p*H meter using glass electrode.

A-5. DETERMINATION OF SILICON

A-5.1 Reagents

A-5.1.1 *Sodium Hydroxide* — solid.

A-5.1.2 *Dilute Hydrochloric Acid* — 1 : 1 and 1 : 20 (*v*/*v*).

A-5.1.3 *Concentrated Hydrochloric Acid*—sp gr 1·16 (*see* IS : 265-1976*).

A-5.1.4 *Dilute Sulphuric Acid* — 1 : 1 (*v*/*v*).

A-5.1.5 *Hydrofluoric Acid* — 40 percent.

A-5.2 Procedure

A-5.2.1 Place 8 to 10 g of sodium hydroxide in the nickel crucible and transfer 0·25 to 0·5 g of the dried and powdered material to pass through a 150 micron IS Sieve, to the crucible depending upon the silicon content of the sample. Cover the crucible with the lid and heat, at first gently and then at the maximum heat for half an hour. Carefully fuse over a low flame, slowly revolving it round the outer edge of the flame till the contents have melted down without spattering. Rotate the crucible carefully to stir any unattacked particles in the bottom and sides, maintaining it at a low red heat. Just before completion of the fusion which requires 3 to 4 minutes, increase the temperature of the crucible to bright redness for one minute. Spread the melt uniformally on the sides and bottom of the crucible by slowly rotating it and allow to cool to room temperature.

A-5.2.2 Extract the melt with minimum quantity of hot water in a porcelain dish, washing the crucible and lid with a jet of hot water. Acidify carefully with dilute hydrochloric acid (1 : 1) and add about 50 ml excess. Evaporate to dryness and bake for one hour at 100 to 110°C. Redissolve the mass in 40 ml of concentrated hydrochloric acid by warming, and dilute with 150 ml of hot water. Raise to boil, allow to settle slightly and filter through Whatman filter paper No. 40. Wash 10 to 12 times alternately with hot dilute hydrochloric acid (1 : 20) and hot water. Finally rinse with hot water till the washings are free from chlorides. Preserve the paper and the residue.

*Specification for hydrochloric acid (*second revision*).

A-5.2.3 Evaporate the filtrate and washings to dryness and repeat the procedure of baking, washing, etc, as given under **A-5.2.2.**

A-5.2.4 Place the papers and residue from **A-5.2.2** and **A-5.2.3** in the platinum crucible and dry completely on a hot-plate. Heat the crucible in a muffle furnace at 1 000°C for about 30 minutes, cool in a desiccator and weigh. Ignite again for 10 minutes at the above temperature as a check for constant weight.

A-5.2.5 Add sufficient dilute sulphuric acid to moisten the residue, then add carefully about 10 ml of hydrofluoric acid and cautiously evaporate to dryness. Ignite over a free flame to constant weight. Record the loss in weight which represents the weight of silica.

NOTE — A blank determination should be carried out when the silica content of the ferro-alloy is below 10 percent.

A-5.3 Calculation

$$\text{Silicon, percent} = \frac{A \times 46{\cdot}72}{B}$$

where

A = mass in g of silica obtained, and

B = mass in g of the sample taken.

A-6. DETERMINATION OF FINENESS

A-6.1 Procedure — Place 10 g of the material on the respective IS sieve and brush it gently with a 25 mm varnish brush for 15 minutes or until no further material passes through the sieve, whichever is the lesser period. Remove the sieve and weigh the portion of the sample retained on it. Express it as percentage of the material taken for the test.

APPENDIX B

(*Clause* 7.1)

B-1. GENERAL REQUIREMENTS OF SAMPLING

B-1.1 For general requirements of sampling, the methods given in IS : 8883 (Part 1)-1978* shall be followed.

*Methods of sampling chemicals and chemical products: Part 1 General requirements and precautions.

B-2. SCALE OF SAMPLING

B-2.1 Lot — All the drums in a single consignment of the material of the same grade drawn from a single batch of processing shall constitute a lot. If a consignment is declared or known to consist of different batches of processing, the batches shall be marked separately and the groups of drums in each batch shall constitute separate lots.

B-2.2 The number of drums to be selected shall depend upon the size of the lot and shall be in accordance with Table 2.

TABLE 2 NUMBER OF CONTAINERS TO BE SELECTED

Lot Size	Number of Containers to be Selected
(1)	(2)
Up to 50	3
51 to 100	4
101 to 150	5
151 to 300	7
301 and above	10

B-2.3 The drums shall be selected from the lot at random and in order to ensure randomness of selection, the method given in IS : 4905-1968* may be followed.

B-3. NUMBER OF TESTS

B-3.1 Tests for determination of ferrosilicon, percent by mass shall be determined on individual drums and for the remaining characteristics tests shall be conducted on composite sample.

B-4. CRITERIA FOR CONFORMITY

B-4.1 For all those characteristics for which individual tests have been conducted average ($\bar{X}$) and range (R) shall be calculated, range being the difference between the maximum and minimum of the test results and

$$\text{Average} = \frac{\text{Sum of the test results}}{\text{Number of tests}}$$

The lot shall be declared as conforming to the requirements of ferrosilicon, percent by mass; if:

$\bar{X} - 0{\cdot}6\ R \geqslant$ the minimum value specified in Table 1.

*Methods for random sampling.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg. m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2